

which contains a certain proportion of its amino groups in their primary form.

- (9) Recently, chitosan was reported to be an efficient retention additive and strengthening agent for mechanical pulps, [M. Laleg and I. I. Pikulik, Nordic Pulp and Paper Res. J., Vol.7, No. 4 page 174 (1992)]. Chitosan is a natural polysaccharide with a structure similar to cellulose but different from cellulose in that every glucose unit of chitosan contains one primary amino group. In acid solution these amino groups become positively charged, making chitosan, in solution, strongly cationic. Chitosan can thus be used in papermaking as a cationic, polymeric retention aid. Chitosan in its papermaking form, is produced from the shells of sea crustaceans. The procedure for the preparation of chitosan from this source is complex, requiring a large amount of chemicals, and yielding only about 20% based on weight of dry shells. Chitosan is, therefore, relatively expensive. Since the world supply of sea shells suitable for industrial production is limited, chitosan from this source cannot be relied upon to satisfy a large scale demand from the paper industry. Thus, a new class of retention additives having the properties of chitosan, but which could be produced in large quantities at low cost, would be highly desirable.
- (10) Dry-strength additives are often used to increase the strength of dry paper and board; cationic starches and water-soluble synthetic polymers such as polyacrylamides are examples. In contrast, wet-end additives